

**Phreatoicus lintoni, a new species of freshwater Isopod from South-Western Australia.** By Professor G. E. Nicholls, D.Sc., F.L.S.

(Read March 11, 1924.—Issued May 30, 1924).

Rather more than forty years ago the first species of this interesting genus was described by Dr. Chilton, his specimens having been taken from water brought to the surface by a well in New Zealand. In the thirty years succeeding that first discovery, some six, or perhaps seven, other species were added. During that period there were discovered other forms, obviously akin to *Phreatoicus* but differing sufficiently from that genus to warrant the establishment of new genera for their reception, the whole collection being constituted a sub-order, the Phreatoicidea. All of these were restricted in their distribution to Eastern Australasia (being known only from New Zealand, Tasmania, and Eastern Australia) and all of the species of *Phreatoicus*, with but two exceptions †, were sub-alpine forms or from subterranean waters, while the members of the related genera were from similar waters or burrowers in damp earth. The majority were eyeless or with but minute eyes. These facts concerning their distribution as well as their structural peculiarities suggested that the extant forms were the survivors of an ancient surface-water fauna that had persisted to the present time in these scattered hiding places. The antiquity of the group was attested a little later by the discovery, in shales of Triassic age from New South Wales, of a fossil form ('17) differing hardly at all from the typical *Phreatoicus australis*.

In 1914, with the discovery of a new species, recorded under the name *P. capensis*, came confirmation of the belief that this genus had once had a much wider range. This new form was found in the waters on the summit and slopes of Table Mountain in South Africa and its discovery was followed, in 1920, by the finding of abundant specimens of a new species, in surface waters of low-lying country in south-central Australia, assigned tentatively to the genus *Phreatoicus* and named *P. latipes* (Chilton/'22). This was a robust form and possessed large, well developed eyes.

† One of these was a blind form *P. kirkii* occurring in a shallow lagoon near the coast of New Zealand, its blind condition being explained upon the supposition that it was derived from an underground form but had reverted to life in surface waters. *P. australis* is said to range from Coast to Mountain top.

During this last twelve months no fewer than three new members of the sub-order have come to light, all from Western Australia. One of these has been referred to a new genus (making the fifth included within the sub-order), the other two western forms are obviously much more closely related to *Phreatoicus*, and one, *P. palustris* Glauert, has already been placed in that genus ('24). It is only after much hesitation that I have included my new species in this genus and, if this and *P. palustris* (and probably *P. latipes* also) are to be retained here, it seems inevitable that the generic diagnosis must be modified somewhat. This is discussed below, when the affinities of *P. lintoni* are considered.

*P. palustris* has been taken from shallow water in a number of places in the vicinity of Perth, and, like *P. latipes*, only from low-lying country. *P. lintoni* resembles both of these in its robust habit, and the possession of well developed eyes, and was found living under somewhat similar conditions. At present it is known only from a small creek, opening into the King River, a distance of twenty miles or less, north-east from Albany, but almost certainly it will be found to occur over a wide tract of country. It was taken by myself in the course of a collecting trip made, during the present summer, along a part of the southern coast of Western Australia, and I have named it after Mr. G. C. Linton, of the Fisheries Department, under whose guidance I made the visit to the King River.

About half a dozen large females and a number of smaller specimens, mostly immature females, but including five small males, were taken (February 12, 1924), in a small creek near the bridge over the King River. This creek has its source in a spring on the summit of a near-by hill, the orifice at the source having been enlarged to hold a small barrel. Upon the staves of this barrel, which were covered by a luxuriant growth of a filamentous Alga, all the larger individuals were found. On the slopes of the hill the water spread out into a swampy patch which yielded a few specimens but at the base of the hill, on flat ground raised very slightly above the tidal waters of the river, the swamp drains into a shallow channel where the peaty water flows sluggishly. The banks of this channel and the many partly-submerged sticks which almost choke it are clothed with a freely growing moss-like liverwort (one of the Jungermanniales) and it was from beneath this growth as well as in the water, that the greater number of the specimens were secured. No females with brood pouches were seen and the males were all so small as to make it doubtful that they could be mature. Only a few, therefore, were preserved at the time, an attempt being made to get the remainder alive to Perth, there to be kept under observation. Unhappily almost all of them died upon the journey.†

†See however addendum.

**Phreatoicus lintoni** n. sp.

Text-Figure and Plates VIII. and IX. (figs. 1 and 4-13).

*Specific diagnosis.*—Body moderately stout, surface smooth with scattered hairs; eyes large, sub-circular; head scarcely longer than second peraeon segment. Peraeon sub-cylindrical, the pleura of segments 1-4 slightly developed, not entirely concealing the coxal portion of the legs; first peraeon segment short, fused with the head, suture distinct; second, third, and fourth segments equal; fifth, sixth and seventh successively shorter, the seventh as short as the first. Pleon of moderate length, having (with the telson) a length approximately two-thirds that of the combined length of cephalon and peraeon or slightly less than that of peraeon segments 2-6; fifth pleon segment as long (measured dorsally) as the third and fourth together, deeply notched behind. The fusion of pleon segment 6 with the telson indicated by a sutural line running obliquely dorsally from the posterior end of the base of the uropod and marked by a short row of stout spines.

Telson large but not sub-conical, being convex above and concave below, *i.e.*, having a horse-shoe shaped transverse section; its postero-dorsal border nearly transverse and slightly arched; the dorsal view (Fig. 1a) showing a broad and shallow median incisure bounded laterally by paired rounded prominences, each bearing a stout spine; its inferior margin produced postero-ventrally into notable spines, the most dorsal pair being particularly stout. In terminal (posterior) view the dorsal margin is seen overhanging considerably the anal area, the anus showing as a conspicuous median longitudinal slit, presented postero-ventrally.

First antenna less than half the length of the second, with a many jointed flagellum; second antenna nearly as long as the head and the first six peraeon segments; right mandible with secondary cutting edge. Gnathopod strongly sub-chelate (*text figure a*), the "hand" relatively small, the sixth joint sub-triangular, palm deeply concave distally, produced proximally into a densely setose prominence, dactyl scarcely shorter than propod; fifth, sixth and seventh legs increasing progressively in length, the coxal regions flattened externally and fused to form the inferior extensions of the related pleura, but with distinct sutures, basal joints flat and greatly produced posteriorly to form rounded lobes, notched inferiorly. Pleopoda 3-5 with epipodites, the second pleopod of the male bearing a penial seta  $1\frac{1}{2}$  as long as endopodite; uropoda, long, stout and spiny, the basal joint extending beyond end of telson. (Fig. 1a).

*Colour.*—Generally of a dark brown; on the dorsal surface there is a broad band of darker brown which deepens in shade towards the lateral margins to form a paired, almost black, line, interrupted inter-segmentally. Laterally, the dendritic pigment spots occur more sparingly upon the brown background so that the sides appear of a somewhat lighter shade of brown. In younger specimens a paler, almost olive, tint prevails, with more sparsely scattered black spots.

*Length.*—The largest specimen, in curved posture, measures about 12mm.; other specimens, slightly less robust, which died extended, reach a length of 14mm., all being females. Greatest breadth of peraeon 3mm. The largest male secured measures barely 7mm. in length.

*Habitat.*—All the specimens taken were secured from a small sluggishly flowing creek and adjacent swamp, draining into the estuary of the King River, a short distance above the spot where that river discharges into Oyster Harbour.

The following detailed description is based upon two of the larger females and a male of rather less than 7mm.

The *first antenna* (fig. 4a) is slender and of considerable length, reaching to about the sixth joint of the flagellum of the second antenna. The well defined peduncle consists of three joints, of which the first and third are of equal length, the second slightly shorter; the first joint is stouter than the second, the third relatively slender. Unmutilated, the tapering flagellum has from fourteen to sixteen joints. The *second antenna* (fig. 4b) is much stouter than the first and more than twice as long; of the five joints of the peduncle the proximal three are moderately stout and subequal in length, the fourth nearly as long as the combined length of second and third while the more slender fifth is but slightly shorter than third and fourth together. The flagellum, which has from 27–30 joints, is  $1\frac{1}{2}$  the length of the peduncle, almost every joint bearing a terminal circlet of short simple setæ.

*Mouth parts.*—The *upper and lower lips* (figs. 5, 9) agree, in general shape, quite well with that of the corresponding structures in *P. assimilis* or *P. australis* (as figured by Chilton, '91, figs. 4, 7, and '93, figs. 4, 6), but appear to be rather more densely setose and, in both structures, the more laterally disposed setæ form a detached tuft of longer hairs.

The *mandibles* (fig. 8), also, agree in general form with those of *P. australis* except that the right mandible retains its secondary (inner) cutting edge. In both mandibles the outer cutting edge consists of four stout teeth, the second and third being longer than the first and last. The left mandible has the strongly chitinised

inner row of three teeth, normally found in all members of this sub-order, while the right has retained an inner cutting edge (fig. 8a) of three teeth, with serrate edges, the median one being the least prominent and the edge as a whole being paler and much less strongly chitinised than the corresponding structure of the opposite side. In the retention of this right inner cutting edge it departs from the condition described in all of the Phreatoicidea excepting only *P. latipes*, *P. capensis* and *Phreatoicopsis terricola*. An examination, however, of the mouth parts of the Western Australian form (*P. palustris*) recently described by Glauert ('24) proves that this, too, retains such a condition of the right mandible, the inner cutting edge in this species consisting of three pale and slender teeth, in this case the central tooth being the longest. The plate-like process lying between the cutting edge and the molar tubercle is fringed by about fifteen moderately stiff setæ, serrated on either side. The palp has much the usual form and proportions, the stiff setæ at the end of the second joint as, also, those fringing the inner aspect of the third joint are pectinate, the two or three long terminal setæ being simple. Two or three remarkable setæ flexible and branching are to be found upon the palp.

The first maxilla (fig. 6) has its inner lobe rising from a somewhat slender stalk and bearing about seven plumose setæ; the outer lobe is fringed externally with numerous plumose setæ and armed terminally with about twelve stiff curved spines, serrated to an unequal extent on two sides.

The second maxillæ (fig. 7) appear to be normal, the inner lobe having one margin provided with twenty or more plumose setæ, while the other edge bears a fringe of close set flexible setæ forming a comb-like structure. Both of the short outer lobes are crowned by long, stiffly curved and pectinate setæ.

The *maxillipedes* (fig. 10), likewise, are in general agreement with those of *P. australis* differing in but a few minor details; the inferior angle of the meros seems to be produced distally to a slightly greater extent. The epipodite, almost circular in shape, has but a single seta on its mesial border while its lateral edge is closely set with numerous fine setæ, a feature recorded in but two or three species of this genus. Corresponding to these there is a feather-like tuft of setæ on the mesial border of the basos.\* The plate on the second joint has the normal relations, with three stout coupling hooks. These are rather more widely separated than in *P. palustris* (where all three lie opposite the meros), the proximal in *P. lintoni* being opposite the ischium, while in *P. latipes* of the three hooks the two more proximal hooks are opposite the ischium. The margin of this plate is fringed with long plumose

\* A similar tuft occurs on the dorsal surface of the epipodite in *P. latipes* just within the proximal lateral border but appears to be missing from the basos. The margin of the epipodite in that species is free from setæ as Glauert states is the case in *P. palustris*.

setæ but terminally the setæ are simple as indeed are most of the abundant setæ on this appendage. Several setæ suggestive of miniature bottle-brushes are to be found on the basos, and these are commonly seen projecting stiffly ventrally beneath the maxillipedes in position (fig. 1).

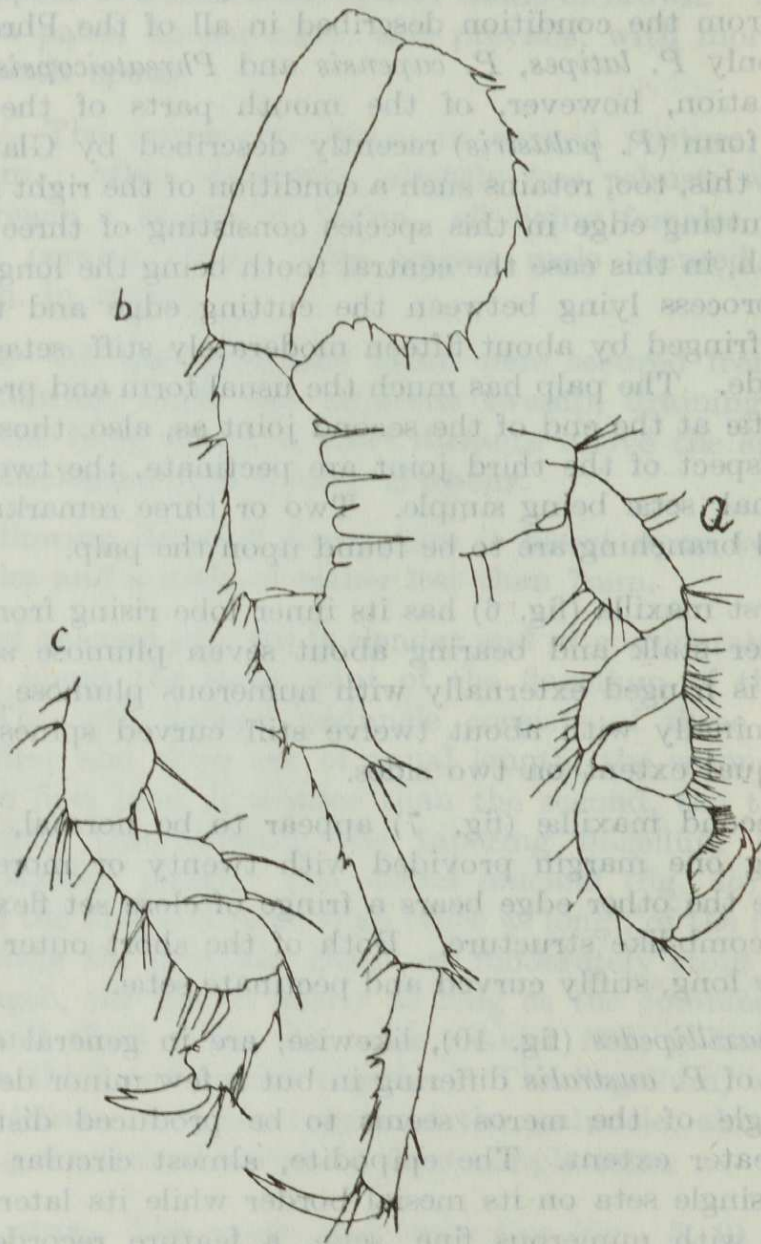


FIGURE : (a.) Gnathopod, (b.) Seventh Peraeopod, (c.) Fourth Peraeopod (male).

(N.B. These are drawn to different magnification.)

*Peraeopoda*.—The first peraeopod (gnathopod) like all the succeeding legs has its coxal portion fused with the epimeron. In the female, the shape and proportions of basos, ischios, meros and carpos agree almost exactly with Barnard's descriptions ('14) of those of *P. capensis*. The "hand," however, is distinctive (Text-fig. a). Relatively small, the propod is sub-triangular, the base

nearly  $1\frac{1}{2}$  the width of the carpos, the anterior margin strongly convex, the palm well defined, concave distally so that the proximal end appears as an outstanding prominence with long stout spiniform setae. The proximal half of the concave portion of the palm bears a narrow ridge, minutely denticulated and running lengthwise. The stout dactylos is slightly longer than the palm; its inner distal end is strongly serrated and the base of the clawed tip has a supporting spinule, the "minute secondary unguis" of Barnard's description. In the largest male, the hand scarcely differs from that above described (unless, perhaps, the palm is slightly less concave) and is not apparently larger than that of a female of the same length.

The second, third and fourth peraeopoda are apparently similar to those of *P. australis*. They are sub-equal in length and slender, with the dactyl much shorter than the propod and have a pronounced secondary unguis. In the male, however, the fourth peraeopoda are slightly modified; the propod is seen to be much wider distally than the related dactyl and has a small palmar surface bearing one short curved spinule (Text-fig. c).

In each of the fifth, sixth and seventh peraeopoda the coxal joint may be discerned externally, its outer surface being flattened and fused with the ventral border of the related pleuron to form a continuous surface. The colouring of these flattened coxal plates is indistinguishable from that of the adjacent pleura, a narrow lighter line alone marking the suture. In all three of these legs there is found an expansion of the basos to form a thin flattened posterior plate, notched inferiorly. The fifth peraeopod is longer than the fourth, the sixth and seventh (Text-fig. b) being much longer than the fifth. All are spinous, certain of the spines, particularly in large specimens, being very conspicuous, very dark in colour and almost rod-like in shape. In all of the peraeopoda there is a well developed secondary unguis.

*Pleopoda.*—The branchial appendages of the pleon (figs. 11, 12, 13), seem to differ little, except perhaps in size, from those of other species of *Phreatoicus*. In several of my specimens they are seen hanging downwards, sometimes almost vertically (in the position assumed by the pleopods of many Amphipoda), the first pair then reaching nearly to the distal end of the ischia of the seventh thoracic legs. In others they lie, backwardly curved (Fig. 1) and in most they are but partially concealed by the pleura. In one example, the fifth pleopod, carried horizontally, was clearly visible in dorsal view, projecting backwards between the uropoda, extending well behind the posterior border of the telson. This partially exposed condition of the pleopods, doubtless attributable principally to their greater relative size and the considerable development of the fringe of plumose setae, is, I think, quite possibly

a normal state, although unfortunately I did not pay attention to the condition of these appendages in the living animal. Barnard, figuring a somewhat similar condition in *P. capensis*, states that these structures are not thus normally exposed. In *P. palustris*, of which I have examined living specimens, these pleopoda are visible in life, the waving lower edges coming well below the inferior margins of the pleura.

The penial filament, on the second pleopod of the male (Fig. 13), is a stout, slightly curved structure, attached proximally to the basal region which is common to this filament and the endopodite. Otherwise it is free throughout its length.\*

*Uropoda.*—These are long (Figs. 1, 1a), the basal joint being very stout, as long as the inner ramus and extending well beyond the end of the telson. The lower margin is straight and prolonged distally into a spine. On the upper surface a broad groove extends the entire length of this basal joint and its margins are spinose, the outer edge notably so. Of the rami, the inner is considerably longer than the outer one and both are tipped with spines.

*Affinities.*—Of the genera of the sub-order, other than *Phreatoicus*, each is known from but a single species and of these one only *Phreatoicopsis terricola* is of particular interest in connection with the new species above described. A burrower in damp earth, *P. terricola* is a robust form reaching a length of approximately two inches and, notwithstanding its subterranean habits, has not yet completely lost its eyes although these have become minute. It was distinguished generically from the closely related *Phreatoicus* principally on account of the shape of its tail-piece (sixth pleon segment + telson) and the related appendages, the uropoda.

In this generic diagnosis, Spencer and Hall ('96, p. 13), have described the telson of *Phreatoicopsis* as "large, sharply truncate," whereas that of *Phreatoicus* is stated by Chilton ('91, p. 151) to be "large, sub-conical." Describing *Phreatoicopsis*, Spencer and Hall remark (op. cit. p. 21) "it is difficult by a single word to express the form of the telson, yet it certainly is not 'sub-conical.' Its sudden truncation and horse-shoe shape in transverse section are features which mark it off strongly from the form found in *Phreatoicus*." From this quotation it will appear that these authors have interpreted the word "sub-conical" in its usual sense of "conoidal" or "nearly conical" and have assumed that the telson of a typical *Phreatoicus* has a surface approaching that of a conical body and, therefore, a transverse section circular or sub-circular

\* The same is true of *P. palustris* and of *Hyperoedesisipus* ('23), and somewhat similar relations are figured in *Phreatoicoides* ('99), the principal difference in the arrangement of these parts being due apparently to the difference in size, relative to one another, which these structures attain. Chilton's descriptions suggest that these same conditions obtain, also, in *P. australis* ('91, p. 163), *P. assimilis* ('93, p. 195), and *P. latipes* ('22, p. 30). Indeed the latter form and *P. palustris* differ from *P. lintoni* scarcely at all apart from differences in relative size of filament and endopodite. It is, therefore, not quite evident what Barnard had in mind when he speaks of this filament being free in *Phreatoicoides* and *Hypsimetopus* and fused in *Phreatoicus*.



in outline. Chilton's figures of *P. typicus* and *P. assimilis* as well as that of *P. australis* (taken in conjunction with his description) would certainly suggest that such is actually the case.

In *P. lintoni*, however, this sub-conical (helmet) shape to the terminal region, though suggested in profile, does not really exist. Seen from behind, the telson presents a horse-shoe shape with the sides quite widely separated, in posterior continuation of the line of the pleura of the pleon segments. Thus, if the large, broad-based spines which fringe the postero-inferior margin of the telson were to become obsolete, a condition of this terminal piece scarcely to be distinguished from that of *Phreatoicopsis* would result. It was the realisation of this fact that made me hesitate to assign this new species to *Phreatoicus* rather than to *Phreatoicopsis*. An examination of the tail-piece in our other western form *P. palustris* led to the discovery that this was closely in agreement with *P. lintoni* in this respect. Moreover, from Chilton's description of *P. latipes* ('22, p. 26), "terminal segment strongly arched above, sides widely separate below," it was evident that there was yet a third species to which the term "sub-conical" could not apply.

All of these three forms (which, for convenience, I may refer to as "western" forms, occurring as they do entirely outside the restricted eastern Australasian area) have yet another important structural feature in common with *Phreatoicopsis*, namely the retention (in a similarly reduced condition) of the secondary cutting edge in the right mandible\*—the retention, that is to say, of a more primitive condition of these appendages, which is apparently still the normal state in some (if not all) Amphipoda.

Furthermore, in these same three forms we have a group showing successive stages in the disappearance of the distinct coxal regions of the hinder peraeopoda. In *P. palustris* (Fig. 2), a short posterior cleft remains to suggest the fact that the lower portion of the downwardly projecting pleura have been furnished by the coxal joints (epimera ?) of peraeopoda five, six and seven. The cleft has vanished in *P. lintoni* but a faint sutural line (unduly emphasized in Fig. 1) still persists; in *P. latipes* all evidence of this coalescence has disappeared.

Again in these same three "western" species we find a series showing the progressive development of that expansion of the plate-like basos which in *P. latipes* is so strongly developed as to give the animal an Amphipod-like appearance. These expansions are moderately developed in *P. palustris*, *P. lintoni* again showing the intermediate state. As compared with *P. australis*, all of these three forms may be said to show this condition to a marked degree.

Yet another feature possessed in common by these three species is the relatively long and tapering first antenna, in which

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\* This condition is found also in *P. capensis*, but the profile only of the telson is described in this species.

the number of joints (including the three of the peduncle) varies from twelve to nineteen. *Phreatoicopsis* has fifteen, whereas all\* other described members of the sub-order have ten or less and, in most, the structure tends to be club-shaped.

One or two other structural details may perhaps be worthy of note. The male appendages are well developed, even in my quite small specimens, and in the larger males of *P. palustris* which I have examined, they are of considerable size. Chilton's figure shows them well-developed in *P. latipes* and very similar in appearance to those of the two Western Australian forms. In some of the eastern species (e.g., *P. assimilis*) these are said to be absent. In *P. australis* they seem to be small. The penial filament while strikingly alike in these three forms, seems to differ somewhat from that figured in other species. The anal opening is a longitudinal slit which is presented postero-ventrally in all of them, whereas in *P. australis*† it seems to be a crescentic slit disposed transversely. Concerning the condition of these organs in *Phreatoicopsis* I have no information.

*Phreatoicus palustris*, *P. lintoni* and *P. latipes* seemed, thus, to form a well defined group with distinct affinities to *Phreatoicopsis* and it became necessary to consider whether all of these would not be more correctly assigned to the latter genus, distinguished from *Phreatoicus* by the shape of the telson, the possession of eyes and of a relatively long and tapering first antenna, and the retention of a secondary cutting edge on the right (as well as the left) mandible. Such a group would include forms of robust habit, inhabiting surface waters in low-lying areas and with a much more definitely Amphipod-like appearance. In this view *Phreatoicopsis terricola* would appear as a less typical member which is, in consequence of a comparatively recently acquired burrowing habit, undergoing degeneration, the eyes tending to become obsolete, the expanded bases of the hinder peraeopoda undergoing retrogression, and the uropods dwindling. To this group *P. australis* would appear to be most nearly allied, modified, perhaps, a little by its restricted sub-alpine habit, but retaining eyes and a moderate development of the expanded bases of the peraeopoda.

The question of relegating *P. latipes* to *Phreatoicopsis* or of establishing a new genus for its reception was evidently considered by Chilton, for, in discussing its affinities, that author stated ('22, p. 25), "Although the species is being placed for the present under the genus *Phreatoicus*, it differs from the other members of the genus in at least two characters . . . . . the greater expansion of the basal joints of the last three pairs of peraeopoda . . . . .

\* I have been unable to verify this statement for *P. kirkii*.

† For specimens of *P. australis*, as, also, of one of *P. latipes* my thanks are due to Mr. Glauert.

(and) . . . . . the apparent absence of the coxal joints of all the peraeopoda." And later (op. cit., p. 32), "Until it is possible to make a revision of the Phreatoicidea, this species may be left under the genus *Phreatoicus* . . . . . It resembles *P. australis* in having the first peraeon segment short and more or less fused with the head, in this character agreeing also with *Phreatoicopsis terricola*, Spencer and Hall.\*"

Chilton proceeds to point out yet further resemblances between *P. latipes* and *P. terricola*, but does not call attention to the fact that these two forms are alike in departing from the sub-conical shape of the telson. It was this omission that led me to examine the telson of *P. australis* in order to ascertain whether or no I had correctly interpreted the original generic diagnosis and I then discovered that *P. australis*, like these western forms, had a horse-shoe shaped section of the telson, perfectly visible when examined from behind.

Probably it is very much less strongly concave below than is *Phreatoicopsis* (of which I have had no material) but it undoubtedly consists of a median portion (the prolongation of the main axis of the body) overhung behind by a terminal projection and continued inferiorly on either side by lateral extensions strictly comparable in position to the pleura of the pleon segments. It thus has quite definitely a horse-shoe shaped, rather than a circular, transverse section and no more than any of the other species which I have examined can it be said to have the telson "sub-conical" although examined in side view, the profile might have suggested that such was its shape. It may well be however, that the term is strictly applicable to *P. typicus* for which form it was originally used and, perhaps, for *P. assimilis* also. In another subterranean form *Hyperoedesipus plumosus* ('23) the telson has the shape of a truncated cone and, therefore, a practically circular shape in transverse section and it is not improbable that in the *Phreatoicus* species with underground habitat the body may likewise have become much more nearly cylindrical and the telson have lost the projecting pleural flaps.

*Phreatoicus australis* clearly has not attained this condition, but, lacking material of these other species, I cannot determine whether, in this respect, it is atypic and, thus, more nearly resembling the western forms and *Phreatoicopsis* than *P. typicus*. If that be not the case and if all of the species of this genus have a telson which (when seen in transverse section) approximates to the shape of a horse-shoe the separation of *P. terricola* from *Phreatoicus* principally on a difference in the shape of the profile of the telson seems scarcely justified.

\* As stated above, this fusion also distinguishes *P. lintoni* and has been described by Glauert for *P. palustris*

Spencer and Hall ('96, p. 21), have called attention, however, to a "small prominent projection of very characteristic form" which terminates the telson in *Phreatoicus* and which is absent in *P. terricola*. An examination of the telson of the western species reveals an interesting series. All lack the projection referred to by Spencer and Hall as distinguishing *Phreatoicus* from *Phreatoicopsis*, but *P. palustris* retains a small rounded apex to the telson (Fig. 2a) which is flanked by a pair of spines. In *P. lintoni* well developed spines are present, but that part of the posterior margin of the telson which separates them is, in this species, actually concave posteriorly (Fig. 1a). This concavity is converted in *P. latipes*, into a narrow and relatively deep incisure (Fig. 3a), so that this form has a terminally cleft telson. Judging from Barnard's figure ('14, Pl. 24, "tels.") the condition of this region in *P. capensis* is not very unlike that of *P. palustris*, but the dorso-lateral spines are not separated from the actual apex; the terminal and characteristic projection, however, seems to be absent.

In the condition of its telson, *Phreatoicopsis* would appear to come nearest to *P. lintoni*, its transverse (dorsal) margin apparently being quite straight as seen from above.

If, however, Chilton intended the term "sub-conical" to describe the shape of the telson, seen in profile, and if the end region of *P. typicus* does not differ essentially from that of *P. australis*, there would be naturally included within the genus a nicely graded series with *P. latipes*, and *P. terricola* at the one extreme, and *P. typicus* at the other, *P. australis* occupying an intermediate position.

Which of these forms is to be considered, however, as retaining more nearly the primitive condition will depend on what view is taken of the relationships of the sub-order.

Stebbing reviewing this question ('93, p. 390), at a time when two species only of the genus had been described, clearly inclined to the view that their structure justified a belief in a definite Amphipodan affinity. He suggested that Chilton, in his admirable discussion ('93) of the characters of the group, had minimised the importance of certain of the structures.

The condition of the more recently discovered species seems rather to lend support to Stebbing's view, for not only are there present, in these forms, all those characters to which he directed attention, but some of them are even more evident, and new resemblances appear. Thus, the expansion of the second joint of the peraeopoda and the definition of the boundary between sixth pleon segment and telson of *P. australis*, cited by Stebbing, are, in these western species, much more obvious features. In addition, the persistence of the secondary cutting edge of right as well as

left mandible and the greater relative length of the first antenna form fresh points of resemblance. In *P. lintoni* there is also the retention of the clasping arrangement of the fourth peraeopod, which has apparently disappeared in other western forms.

In the alternative view this combination of characters, so suggestive of the Amphipoda, has to be explained as due merely to convergent evolution. It is surely probable, however, that the ancestral Phreatoicid sprang from a marine edriopthalamous stock which invaded surface fresh waters little above sea level. From such situations, the ascent of streams to their source and the occupation of the cold sub-alpine waters would be an easy matter and in time might be expected to produce smaller sub-alpine forms which would be likely to persist in isolated regions long after the low-land forms had disappeared over much of their original range. The derivation of subterranean water forms or of burrowing land forms is readily to be anticipated under the climatic conditions prevailing over much of Australasia. In this view, a form such as *P. palustris* or *P. lintoni* might well be considered as more nearly retaining original characteristics, and its Amphipod-like appearance would be interpreted as evidence of affinity rather than as mere convergent resemblance to the Amphipods.

#### ADDENDUM.

After this paper had been read, I received additional material from Mr. Linton, including some living specimens. Weather conditions were very unfavourable at the time and none survived more than a few days. The material supplied, nevertheless, some further facts of interest. It included several females with brood pouches; a single large female (without pouch) attained to a length of 20 mm. and there was one male of 10 mm.

From the living material I was able to satisfy myself that the pleopoda were distinctly visible below the pleura of the related segments, a condition which, as noted above, obtains also in *P. palustris*.

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## EXPLANATION OF PLATES.

## VIII.

1. Lateral view of *Phreatoicus lintoni* (female).
- 1a. Dorsal view of the telson of a smaller specimen of *P. lintoni*.
2. Lateral view of *P. palustris* (male.)
- 2a. Dorsal view of the telson of *P. palustris*.
- 3a. Dorsal view of the telson of *P. latipes*.
- 4a. First antenna of *P. lintoni*.
- 4b. Second antenna of the same.

## IX.

All figures refer to *P. lintoni*.

5. Upper lip.
6. First maxilla.
7. Second maxilla.
8. Left mandible.
- 8a. Toothed edges of right mandible.
9. Lower lip.
10. Maxilliped.
11. First pleopod of female.
12. Third pleopod of female.
13. Second pleopod of male.